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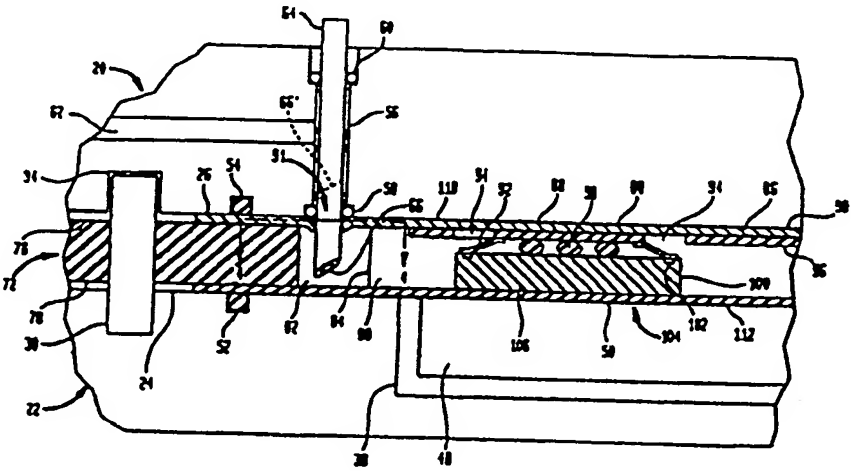

(57) Abstract

Microelectronic assemblies are encapsulated using disposable frames (72). The microelectronic assemblies (104) are disposed within an aperture (80) defined by a frame. The aperture is covered by top and bottom sealing layers (110, 112) so that the frame and sealing layers define an enclosed space encompassing the assemblies. The encapsulant is injected into this closed space. The frame is then separated from the encapsulation fixture and held in a curing oven. After cure, the frame is cut apart and the individual assemblies are severed from another. Because the frame need not be held in the encapsulation fixture during curing, the process achieves a high throughput.

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Tech Insights

Exploring power-management design issues for advanced systems

MOSFETs Break Out Of The Shackles Of Wirebonding

By Replacing Wirebonds With A Copper Strap, Power MOSFETs Finally Enter A New Era Of Electrical And Thermal Efficiency.

Patrick Mannion

With processors, automotive electronics, and telecom board-mount applications all demanding greater power densities, thermally inefficient, high-resistance devices are wreaking havoc on system reliability. At the same time, power lost due to electrical inefficiency is draining valuable system resources. Add this to ongoing demands for lower cost, and it becomes apparent that traditional paths to efficiency nirvana are fast approaching diminishing returns. These paths, which follow the age-old practice of increasing silicon efficiency, have been so successful to date that the packaging and wirebond connections external to the die are now being recognized as the leading contributors to device inefficiency--not the die itself.

Recognizing this, International Rectifier, El Segundo, Calif., has replaced the wirebonds connecting the source to the leadframe with a solid copper strap that covers the surface of the die. This provides a highly conductive path, thermally and electrically, from the die to the leadframe and pc board. According to IR, this has resulted in a 10 to 20% reduction in thermal resistance and a 61% reduction in package contribution to electrical resistance for source connections. Called CopperStrap, the technology provides a 10 to 20% reduction in silicon temperature rise, allowing for less paralleling of MOSFETs, smaller chips and package outlines, and higher reliability.

Circumventing wwirebonding allows the CopperStrap to decrease assembly time and eliminates dreaded cratering and "purple plague" phenomena associated with wirebonds. Though not quantified as of yet, the connection methodology all but eliminates wirebond-related source inductance, a feature of

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4 milliohms in the SO-8: Vishay Siliconix Sets New Record For Power MOSFET On-Resistance

New Package Technology Yields Nearly Twofold Improvement Over Previous State-of-the-Art

SANTA CLARA, CALIFORNIA - December 9, 1998 - Vishay Siliconix today announced a major breakthrough in power MOSFET performance with the release of an n-channel device offering maximum on-resistance of just 4 milliohms in the SO-8 package. The new Si4430DY is one of three new LITTLE FOOT® devices that combine Vishay Siliconix's 32-million cell TrenchFET® silicon with an advanced technique that dramatically reduces the packaging contribution to overall device resistance.

"With our 32 million cells per square inch TrenchFET technology, which remains the state of the art for power MOSFETs, Vishay Siliconix power MOSFETs reached the point where approximately half the total on-resistance for an SO-8 device was in the package components rather than the silicon," said Dr. Felix Zandman, Chairman of the Board and CEO of Vishay Intertechnology, Inc. "The next logical step was to reduce the resistance of the package itself, which is what we have done in these new LITTLE FOOT devices, with dramatic results."

To create these new LITTLE FOOT devices, Vishay Siliconix has developed a proprietary PowerConnect™ technology to replace the bond wires found in traditional power MOSFET packages with a direct connection between the silicon die and the copper lead frame. The result is to increase the number of leads that are directly connected to the chip.

This maximizes the thermal performance and increases the package area available for active silicon. Certain aspects of this technology are the subjects of a pending patent application.

The new 4-milliohm Si4430DY can handle up to 22 A of current and will dissipate up to 3.5 W, a nearly two-fold improvement over any previous power MOSFET in the SO-8 package. With power dissipation capabilities comparable to much larger devices, it will allow designers of Pentium II power conversion circuitry in desktop computers to replace the DPAK power MOSFETs now used in this application with the much smaller LITTLE FOOT SO-8 device. Current handling is so improved compared to previous-generation devices that the number of MOSFETs used as switching elements

can be cut in half.

Using the same packaging technology in a much smaller footprint, Vishay Siliconix is also offering two p-channel devices for bidirectional blocking battery disconnect applications. The new Si3801DV and Si3803DV are the first products on the market to provide a complete reverse blocking function with two MOSFETs in a LITTLE FOOT TSOP-6, allowing designers to implement dual battery systems with a package measuring just 3.02 x 2.84 x 1.01 mm. These new devices will allow manufacturers to provide this useful feature more affordably, and with less board space, than was ever before possible.

The new Si3801DV and Si3803DV provide the industry's lowest on-resistance for a p-channel battery switch in this package type, just 250 milliohm total for both MOSFETs in series. For very low-voltage systems, the Si3803DV is specified for operation at gate drives as low as 1.8 V. Vishay Siliconix is the industry's first supplier to offer power MOSFETs with a 1.8-V operating voltage. An additional 12 such devices, which are essential components in the development of ultra-low-voltage portable systems, are being separately released by Vishay Siliconix.

Samples of the Si4430DY, Si3801DV, and Si3803DV are available now. Production quantities are available in Q4 1998 for the Si3801DV and Si3803DV, and in Q1 1999 for the Si4430DY.

Siliconix (NASDAQ: "SILI"), a company of Vishay Intertechnology, Inc., is a leading manufacturer of power MOSFETs, power ICs, and analog signal processing devices for computers, cell phones, fixed communications networks, automobiles, and other electronic systems. With 1997 worldwide sales of $322 million, the Company's facilities include Class 1, six-inch wafer fabs dedicated to the manufacture of power products in Santa Clara, California and Itzehoe, Germany. Analog switches, analog multiplexers, and low-power transistors are fabricated in the Company's four-inch wafer fab in Santa Clara and by a subcontractor in Beijing, China. Assembly and test facilities include a Company-owned facility in Taiwan, a joint venture in Shanghai, China, and subcontractors in the Philippines, India, and Taiwan.

Vishay Intertechnology, Inc. (NYSE: VSH), a Fortune 1,000 company with revenues running at an annual rate of approximately $1.6 billion, is the largest U.S. and European manufacturer of passive electronic components (resistors, capacitors, inductors) and a major producer of discrete semiconductors (diodes, optoelectronics, transistors), IrDCs and power ICs. The company's components are vital to the operation of everything electronic and can be found in products produced by virtually all U.S. and European electronics equipment manufacturers. With headquarters in Malvern, Pennsylvania, Vishay employs over 20,000 people in over 60 facilities in the U.S., Mexico, Germany, Austria, Hungary, the United Kingdom, France, Portugal, the Czech Republic, Israel, Japan, Taiwan, China and the Philippines.

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Products: Analog Switches Capacitors Connectors Diodes & Rectifiers Frequency Control Integrated Modules Magnetics Measurement Sensors MOSFETs Optoelectronics Power ICs Resistors RF Transistors

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